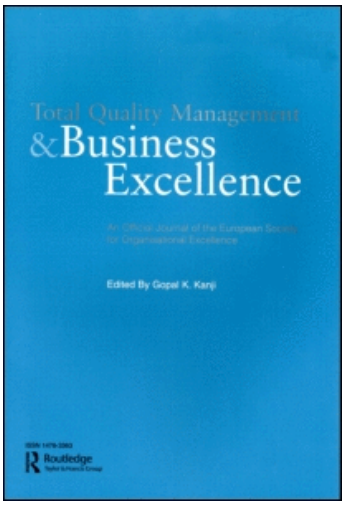

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ISO 9000 and ISO 14000 standards: A projection model for the decline phase

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During the past few years, the process of standardisation with regard to business management systems has accelerated in an economic environment characterised by a marked process of economic globalisation and integration. Thus, the peaks attained by some standards published by agencies specialising in standardisation in the economic field are noteworthy. Two series of standards issued by the International Organization for Standardization (ISO) stand out amongst these: the ISO 9000 series, related to the implementation of quality systems, and the ISO 14000 series, related to the implementation of environmental management systems. Previous research has analysed different projection models regarding number of certificates, both nationally and internationally, with the logistic model standing out as one of the models better suited to data records, and thus believed to offer better outlooks. However, none of the models referred to included data on countries experiencing clear decertification in terms of number of certificates of the aforementioned standards in their calculations, such as the data that has been detected for the first time in the last two years. Faced with the appearance of the first symptoms of market exhaustion, this article discusses what the projection model could be like once a process of decertification has set in.

Keywords: standardisation; quality management; environmental management; ISO 9000; ISO 14000; diffusion

Introduction

During the past few years, there has been a significant growth in the standards issued by agencies specialised in standardisation in the economic field. This growth of standardisation has been largely due to the marked process of economic globalisation and integration that western economies have experienced throughout the last two decades (Mendel, 2001).

Standardisation could be generically defined as that activity aimed at putting order into repetitive applications that arise in the field of industry, technology, science and the economy (Dale, 2002). In its beginnings at the start of the 20th century, standardisation arose to limit the anti-economic diversity of components, parts and supplies so as to favour their interchangeability, facilitating serial production and the repair and maintenance of products and services. In a global economy without standardisation and the fruits of it – regulations, standards and technical specifications – exchanges will be made exceedingly difficult. Consequently, standardisation fosters international trade thanks to the elimination of obstacles owing to different national practices. Notwithstanding, on many occasions these standards form non-tariff barriers for international business relations as they are not truly global. Thus, and as has been highlighted by different authors, while there are fewer and fewer tariff barriers, non-tariff barriers – technical

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standards and regulations that affect the requirements of products, services and, indirectly, production processes – take on greater importance (Blanco & Bustos, 2004; Krugman & Obstfeld, 2003).

At present, there is a great number of national and international standards attempting to order and systematise – amongst other things – the implementation of business management systems in terms of very different functions and operating activities, such as quality improvement (ISO 9000, TS 16949, QS 9000, EAQF, VDA, etc.), environmental impact (ISO 14000 and EMAS), occupational hazard prevention (OHSAS 18001), corporate social responsibility (SA 8000, AA 1000 and the ISO 26000 draft standards), R&D activities (the Spanish UNE 166000 EX experimental standard) and activities related to the management of human resources (Investors in People). All of these standards, which will be included in the set of Management Systems Standards (MSS), are dealt with. However, it must be made clear that these MSS are not based on standards that refer to the attainment of a specific objective or result – that is to say, they are not result or performance standards, but rather are standards which establish the need to systematise and formalise a whole series of business procedures related to the different fields of business management in a series of procedures (Casadesús & Karapetrovic, 2005).

From a global perspective, the success of disseminating all these management standards would seem to be closely linked to the dynamics themselves of the globalisation process of Western economies and the main players in them – multinationals: if standardisation originally came about in order to limit the anti-economic diversity of components, parts and supplies in an economic environment in which outsourcing and delocation of business activity prove to be cornerstone strategic elements, it must nowadays promote a certain homogeneity in business management systems in order to favour such processes. Specialists in this field point out that in the absence of a regulating power of a global public nature, the task of designing, implementing and enforcing standards has increasingly tended to be taken on by different regional or global institutions of a non-governmental nature in areas which have traditionally belonged to the field of regulation of public powers (Abbott & Snidal, 2001; Brunsson & Jacobsson, 2000; Neumayer & Perkins, 2005).

All these standards implement very similar methodologies of creation, structuring, implementation and *third-party* verification processes. Two series of standards issued by the International Organization for Standardization (ISO) stand out amongst these standards, due to their successful dissemination: the ISO 9000 series, related to the implementation of quality systems, and the ISO 14000 series, related to the implementation of environmental management systems.

The ISO 9000 phenomenon has aroused great interest and has been extensively studied in the academic field. On an international level, there is a great deal of empirical research focused on the study of ISO 9000 implementation – studies that analyse, amongst other factors, the motives behind the implementation of the standard and the results that the standard obtains (foremost among others: Brown & van der Wiele, 1995; Buttle, 1997; Carlsson & Carlsson, 1996; Lee et al., 1999; Leung et al., 1999; Romano, 2000; Santos et al., 1996; Tang & Kam, 1999; Terziovski et al., 1997; Vloeberghs & Bellens, 1996; Withers & Ebrahimpour, 1996). The literature is not as profuse as regards research analysing ISO 14000 implementation, although diverse research work has been carried out (Mohammed, 2000; Nakamura et al., 2001; van der Veldt, 1997; Zabihollah & Szendi, 2000, among others). The results of these studies are very diverse, although, in general, it could be stated that external factors, especially the coercive pressure of customers, are of great importance as motivators in the implementation of the standards referred to. As regards the methodology used in all these studies, it must be pointed out that they are generally based on opinions obtained from surveys circulated amongst the quality managers of companies, and thus reflect an inherent bias.

On the other hand, there are different studies that have attempted to analyse this matter from a broader perspective by using aggregate data corresponding to countries that implement these standards, thus trying to describe what the underlying conditions are in terms of a greater or lesser tendency of countries towards certification. In the case of the ISO 9000 standard, for instance, these studies stress that there exists a positive correlation between the number of aforementioned certificates and macro-economic variables such as the volume of direct overseas investment, the tendency to export to the EU and the country's public expenditure (Guler et al., 2002; Neumayer & Perkins, 2005).

Recently, a few academic works focusing on the endogenous process of ISO 9000 dissemination itself have been carried out internationally, among which that of Franceschini et al. (2004) and Saraiva and Duarte (2003) may be highlighted. Now, in the academic literature known to us, only Professors Corbett and Kirsch (2001), an extension of the research carried out by Vastag (2003), and Casadesús et al. (2006) have analysed the joint dissemination of ISO 9000 and ISO 14000. These studies are interesting in our opinion, not only due to their descriptive and predictive capacity regarding the dissemination process of these international standards per se, as highlighted by the authors, but also because they offer certain empirical evidence with regard to whether there exists an analogy between the dissemination process of these standards and the dissemination of innovations in general.

Now, there is a crucial difference between the studies found and the present. All this research work was done at a time when the number of certificates was growing year by year, with both standards in clear expansion, a situation that is very different from the present one in many countries. In fact and as the ISO itself includes in its latest annual report, in which the international dissemination of both standards is analysed, there has been a certain decertification in the number of certificates in recent years in several of the countries that had historically been leaders in this area (see ISO, 2005).

The purpose of this article, with its clearly exploratory and pilot content, is to analyse in detail whether certain homogeneous guidelines exist in the decline phases of the dissemination process of the ISO 9000 and ISO 14000 certificates on an international level – a decline phase that might be defined as the concept of decertification – in addition to attempting to analyse whether it is possible to assess the scope of these decline phases, which proves to be of interest for the different agents involved in the implementation of the aforementioned standards.

From the exploratory and projective work carried out, some proposals that could be tested in future work are also specified in the final part of this article.

ISO 9000 and ISO 14000: current situation of the leading MSS standards

The ISO 9000 series serves as a reference model for the establishment of a quality assurance system in corporations. Since the end of the Second World War, a large number of models or Quality Assurance standards have arisen (for example, the Allied Quality Assurance Publication in military circles, or the standards set by the large multinational automotive companies). Thus, in order to control the rampant development of different Quality Assurance standards, the British Standards Institution (BSI) – the United Kingdom standards agency – developed the BS 5750 series in 1979, later to be used as the basis for the structure of the ISO 9000 standards series (Chittenden et al. 1998; Dale, 2002). Indeed, ISO 9000 standards were established for the first time in 1987. In 1994, these standards were revised. During the last quarter of 2000, a new review was carried out in which an attempt was made to highlight the orientation towards integrated quality management and the excellence of the series. The ISO 9000:2000 series comprises three standards. Only one of them – ISO 9001:2000 – is certifiable. All companies are certified by demonstrating that their efforts comply with the requirements specified

in ISO 9001:2000. Thus, strictly speaking, when the rest of this research refers to the number of ISO 9000 certificates, it is referring to ISO 9001. Nonetheless, out of respect for the custom extensively practised in the literature, we shall continue to talk about 'ISO 9000 certificates' in many cases.

Before analysing the dissemination of this standard, it would be interesting, from our point of view, to clarify properly an important question that usually causes confusion regarding this standard. The ISO 9000 standards are not standards that measure company product or service quality; i.e. they are not standards that refer to compliance with a certain objective or result, but rather standards that establish the need to systematise and formalise an entire series of business processes into procedures. Complying with ISO 9000 indicates that a series of standardised and documented procedures are consistently used in order to produce the product or service that the client purchases. In effect, this management tool is based on the systematisation and formalisation of tasks in order to achieve uniformity in the product and compliance with the specifications established by the client (Anderson et al., 1999). In our opinion, this clarification is totally relevant, since it often happens that significant misunderstandings in this regard have arisen in very different fields.

With regards ISO 14000, it is important to point out that this is a standard establishing a reference model for implementing a company environmental management system, defined as that part of the global management system that describes the organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for preparing, applying, reviewing and maintaining the company's environmental policy. The ISO 14000 standards were published in September 1996 (although some companies had already been certified in accordance with a previous draft). The last review of the standard dates from 2004. A transition period that ended in May 2006 was established. From that point onwards, the ISO 14001:2004 standard would be the only one acknowledged by the IAF (International Accreditation Forum) member states.

Some clarifications similar to those that have been made as regards ISO 9000 must also be made with respect to the content and scope of this standard. ISO 14000, with a structure and formulation that is very similar to ISO 9000, is not a standard that measures the environmental impact of the companies that implement it, but rather, establishes the manner of systematising and formalising procedures related to the company's environmental impact processes. Consequently, it is likewise not a standard dealing with objectives or results, but rather with procedures. From the point of view of management systems and taking into account that their area of applicability is different, it could be affirmed that one of the main differences existing between the two standards is due to the fact that ISO 14000 does indeed establish – however tenuously or ambiguously – a reference for the compliance of certain environmental objectives, since it holds that companies must commit themselves to compliance with the elementary environmental standards and regulations in force in each setting. The more rigorous European standard EMAS establishes the need to comply with said standards and regulations.

As has been said, at present, the dissemination of the two standards – in particular, of ISO 9000 – has been very successful. The latest data offered by ISO (ISO, 2005) indicates that, as of December 2004, there were already 154 countries with ISO 9000-certified companies, and the number of certificates worldwide is at least 670,399. When ISO 14000 was published, 127,349 certificates had already been issued for ISO 9000. Like ISO 9000, ISO 14000 was also disseminated worldwide, although not with the same degree of success for the time being. The latest data available, also dating from December 2004 (ISO, 2005), indicates that 90,569 ISO 14000 certificates have already been issued in a total of 127 countries.

Before proceeding with an analysis of the data obtained, it should be specified that data supplied by the ISO regarding the number of certifications worldwide is used in this research, in

particular the latest data available in the ISO (2003), ISO (2004) and ISO (2005) reports. It is very important to take into account that these data – the only data available, must be viewed with some caution, as they may contain some errors or aspects that need to be qualified. First, it should be taken into account that the current version of both standards allows having a single site certification, which would explain a huge reduction if the multinational firms apply this model, although the details provided by ISO (ISO, 2005) do not place importance on this. Secondly, the ISO organisation itself acknowledges the fact there are some errors in its data, as this is compiled via organisations from different areas in each specific country in a different way. That is why the reduction in the number of certifications analysed in this article is not necessarily only due to companies that have stopped being certified, but rather may be due to other reasons which are difficult to contrast in any research work.

Having said this, and analysing the data given by ISO itself in more detail, it is easy to see how the situation is not so optimistic. Making a comparison using the latest data available (ISO, 2003; ISO, 2004 and ISO 2005), and bearing in mind the 13 countries with the greatest number of certificates – which reflects more than 70% of all certificates worldwide – we obtain the data reflected in Table 1. The nature of the analysis that is being attempted to be carried out from country to country makes it very difficult to work with a large number of countries, as well as quite possibly being of little relevance. That is why, throughout the research, a decision has been made to focus solely on the 12 leading countries in ISO 9000 certifications, their behaviour probably being similar to that of the other 114 countries with companies that have implemented both standards – countries that only represent 30% of certificates worldwide.

It is important to point out different aspects in Table 1: on the one hand, there are some countries in a declining process as regards dealing with the number of ISO 9000 certificates, with very marked drops in Australia and Canada, compensated on a worldwide scale by the strong growth of China, Italy and Spain. Thus, although the number of certificates is globally increasing, the situation is worrisome, since various economically significant countries have already started a trend towards decertification. On the other hand, regarding ISO 14000, it is

Table 1. Number of ISO 9000 and ISO 14000 certificates in the 13 countries with the highest number of certificates in 2002, 2003 and 2004.

	ISO 9000 (2002)	ISO 9000 (2003)	ISO 9000 (2004)	ISO 14000 (2002)	ISO 14000 (2003)	ISO 14000 (2004)
China	75,755	96,715	132,926	2803	5064	8862
Italy	61,212	64,120	84,485	2153	3066	4785
United Kingdom	60,960	49,151	50,884	2917	5460	6253
USA	38,927	41,571	37,285	2620	3553	4759
Germany	35,802	24,889	26,654	3700	4144	4320
Japan	33,964	55,916	48,989	10,620	13,416	19,584
Spain	28,690	33,125	40,972	3228	4860	6473
Australia	27,135	19,975	17,365	1485	1250	1898
France	19,870	18,007	27,101	1467	2344	2955
Republic of Korea	14,520	12,846	12,416	1065	1495	2609
Netherlands	13,198	10,309	6402	1073	1162	1150
Canada	12,371	11,759	9286	1064	1274	1492
Switzerland	10,299	9063	11,549	1052	1155	1348
Total sample	432,703	447,446	506,314	35,247	48,243	66,488
Total world	561,747	567,985	670,399	49,449	66,070	90,569
Percentage	77.0%	78.8%	75.5%	71.3%	73.0%	73.4%

Source: Put together by the authors from ISO (2003), ISO (2004) and ISO (2005).

easy to note how such behaviour is not detected. There continues to be a certain growth in the great majority of countries, with the exception of China, where the increase is very high. As is observed in Casadesús et al. (2006), it seems normal that this should be the case, since the implementation of the standard in question has always taken place under the aegis of its famous predecessor.

In order to be able to compare the number of certifications existing in each country, taking into account the relative importance of the economies of those countries, a relevant analysis involves studying the intensity of certification by means of certain rates created for this study. This intensity of certification in ISO 9000 (r9) and ISO 14000 (r14) are the relationship between the number of certificates and an indicator of the GDP of each country. This indicator is the simple average of the GDP of the three years expressed in 1.00 E+09 current US dollars. Hence, this indicator does not make economic sense; it is used as a deflator constant over the three years to avoid the fluctuations between the US dollar and the currency of each country. Without a doubt, it would be even more interesting to calculate this intensity, not in accordance with its contribution to GDP, but rather, for example, in accordance with the number of plants or industrial companies in each of the countries. Yet the real difficulties inherent in being able to avail ourselves of appropriate data make it necessary to use the indicator mentioned.

Analysing the intensity of certification using the aforementioned rates, as noted in Table 2 in the case of the ISO 9000 certification, a significant decertification in the majority of the 13 countries analysed may also be observed, particularly in countries such as Australia. Conversely, the situation is very different in the case of the ISO 14000 standard, in which all the countries analysed evidence growth in terms of this rate. This growth may even be deemed spectacular in countries such as China, the Republic of Korea, Italy, France and Spain, in which this rate has doubled in the last three years.

Faced with this apparent decertification issued in highly relevant countries on a worldwide scale, different questions arise: did the models of dissemination existing in the literature foresee such a decertification? And the most important consideration is, can this decertification show us the trend that the rest of the countries are gradually going to follow?

Table 2. ISO 9000 and ISO 14000 certification index in the 13 countries with the highest number of certificates in 2002, 2003 and 2004.

	r9 (ISO 9000 intensity)			r14 (ISO 14000 intensity)		
	2002	2003	2004	2002	2003	2004
China	52.41	66.91	91.96	1.94	3.50	6.13
Italy	42.44	44.46	58.58	1.49	2.13	3.32
United Kingdom	33.25	26.81	27.76	1.59	2.98	3.41
USA	3.53	3.77	3.38	0.24	0.32	0.43
Germany	15.12	10.51	11.26	1.56	1.75	1.82
Japan	7.90	13.01	11.40	2.47	3.12	4.56
Spain	34.63	39.99	49.46	3.90	5.87	7.81
Australia	52.09	38.34	33.33	2.85	2.40	3.64
France	11.47	10.39	15.64	0.85	1.35	1.71
Republic of Korea	23.74	21.01	20.30	1.74	2.44	4.27
Netherlands	26.27	20.52	12.74	2.14	2.31	2.29
Canada	14.49	13.77	10.88	1.25	1.49	1.75
Switzerland	32.39	28.50	36.32	3.31	3.63	4.24

Source: Put together by the authors from ISO (2003), ISO (2004), ISO (2005) and data from OCDE.

Diffusion models

The literature relating to dissemination of the different management tools and systems is very extensive, since this is a research topic that has enjoyed great interest amongst the academics of different fields (the synthesis reflected in Rogers, 1995, is particularly interesting). Specifically, there is extensive literature on studies dealing with the dissemination of innovative technologies, which can also be applied in some form to management innovations, i.e. to innovations in general, such as Teece (1980) does, demonstrating that the models of technological innovation are not limited to tangible products. From these studies, it may be roughly deduced that the accumulative adoption of innovations over time follow an S-shaped or sigmoid curve reflecting the fact that few members of a social system adopt an innovation in practice during its first stages, and that the rate that innovations are adopted rises until the process reaches its saturation point, when the growth rate falls anew. Stoneman (1995) affirms that this model usually explains the phenomena of diffusion in the field of new technologies clearly.

Some studies tackling questions similar to those formulated in this study, however incipient, have already been carried out in specialist academic literature. With regard to the development of the ISO 9000 and ISO 14000 standards, Corbett and Kirsch (2001) propose a regression model that explains the number of ISO 14000 certificates in a given country on the basis of its exporting capacity, its degree of commitment to the environment and the number of ISO 9000 certificates issued in that country. However, it must be taken into account that this interesting study is of a static nature: it does not analyse the development of both standards, ISO 9000 and ISO 14000, over time. From the study carried out, these authors conclude that the number of ISO 9000 certificates in a given country is one factor that explains the number of ISO 14000 certificates issued in the same country; however, they neither specify how such a dissemination occurs, nor do they analyse the sectoral factor, which, as they themselves state in the conclusions of their research, would be an interesting analysis.

On the other hand, Franceschini et al. (2004) have established that the logistic curve helps explain the dissemination of ISO 9000. As reflected in mathematical literature, the model of the logistic curve was applied for the first time by the Belgian mathematician Verhulst during the 19th century in the field of biology, to account for the growth of a species. According to this model, the growth rate is at a maximum at the start, when there are very few individuals in the species that scarcely have to compete for limited resources, and it becomes zero once a certain size is reached. This is the size of saturation that the available resources permit. The model responds to the following expression:

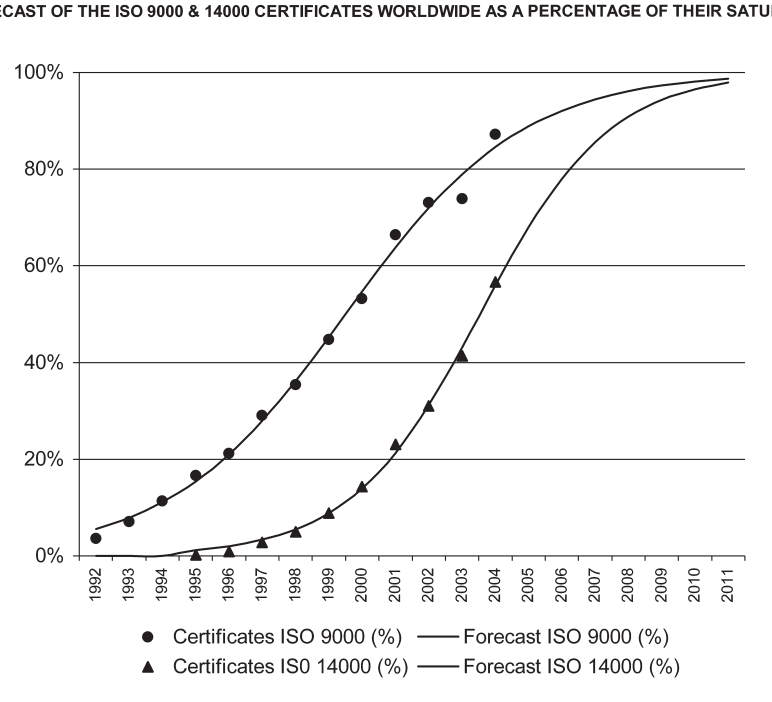
$$N = \frac{N_0 K}{(K - N_0)e^{-r_0 t} + N_0}$$

in which N represents the number of certificates, a function of time. N_0 represents the number of certificates at the starting point. K is the maximum level that may be reached: the saturation level. The initial growth rate is determined by r_0.

On the basis of the aforementioned work, Casadesús et al. (2006) perceive how the logistic model in question is also applicable to the ISO 14000 standard. This research is based on the premise that the increase in the number of certificates for both standards would be proportional to the number of existing certificates at a given time. In addition, the same work observes how the dissemination referred to takes place in a rather similar way with respect to rates of concentration and instability in the different economic sectors that the authors analyse. Thus, they conclude by affirming that both standards have very similar behaviour as regards their dissemination. In fact, Corbett and Kirsch (2001) and Vastag (2003) had already affirmed that

one of the factors that could account for the number of new ISO 14000 certificates in a certain country is precisely the number of ISO 9000 certificates.

Applying the logistic models previously mentioned to current worldwide data, in which countries experiencing a drop in the number of certificates are detected for the first time, Figure 1 is obtained. The data were taken from a report on development published by the ISO itself – the most reliable global information that can be obtained – even though ISO warns, in the introduction to these statistics, that ISO 9000 and ISO 14000 certificates are issued by local entities in each country, and thus, there is no 'official' database of certified companies. From this, it may be observed how the said model suits the current certification data perfectly, with a fit of more than 99% for *R* squared in both curves. At present, we would be at 87.2% of the saturation level for ISO 9000 and 56.7% for ISO 14000, which, as Casadesús et al. (2006) point out, has a faster growth than ISO 9000. Considering 95% as the possible saturation percentage



Decertification of ISO certificates worldwide considering the logistic curve.

	ISO 9000		ISO 14000	
	DF	Sum Sq	DF	Sum Sq
Regression	3	1,808,129,632,554	3	17,148,715,728
Residual	10	3,012,861,774	7	24,824,834
Uncorrected total	13	1,811,142,494,329	10	17,173,540,563
(Corrected total)	12	569,641,663,959	9	8,533,644,566
R squared		0.995		0.997

	Value	LL	UL	Value	LL	UL
N_0	42,579.91	29,562.38	55,597.44	1945.10	939.40	2950.81
K	768,973.99	673,081.67	864,866.30	159,730.70	99,146.39	220,315.02
r_0	0.3776	0.3158	0.4394	0.5147	0.4132	0.6163

LL: Lower limit of the 95% confidence interval.
UL: Upper limit of the 95% confidence interval.

Figure 1. Forecast of the ISO 9000 and ISO 14000 certificates worldwide as a percentage of their saturation.

limit, the forecast according to this model is to arrive at a maximum of 770,000 ISO 9000 certificates and some 160,000 ISO 14000 certificates worldwide.

Analysing individually by country, as Casadesús et al. (2006) have done with some countries, it is easy to observe how the aforementioned logistic curves adapt practically 100% to the empirical data compiled.

The ISO 9000–ISO 14000 diffusion relationship

For the purpose of analysing the relationship between ISO 9000 and ISO 14000 certifications, it has been decided to continue to work with the 'Certification Intensity' indicator previously mentioned. As has already been said, although this may be improved, it at least allows us to work with data that may be better contrasted, since otherwise it would be impossible to compare the number of certificates in countries with a potential such as China's, against that of countries of a smaller size.

The representation of certification intensity rates for both standards on one and the same graph for the 13 countries that have the greatest impact on an international level yields the graph shown as Figure 2, on which the mean values of both variables have been marked through the use of a horizontal line and a vertical line that divide the graph into four quadrants.

In Figure 2, it is clearly observed that the two variables are related, with a Pearson's correlation factor of 0.501 at a significance level of 0.081. In any case, what is most relevant is to point out, as Corbett and Kirsch (2001) affirm, that the number of ISO 14000 certificates in a country has a certain relationship with the number of ISO 9000 certificates in that same country, some years after the analysis carried out by these authors. Moreover, it may be perceived that very few countries are not to be found in the lower left-hand quadrant, in the first upper right-hand quadrant, or over the limit of the quadrants referred to, implying that the countries which, for one or another reason, are relevant with regard to one standard and not relevant with regard to the other, are in the minority. In this sense, Japan is possibly the most noteworthy, having a low ISO 9000

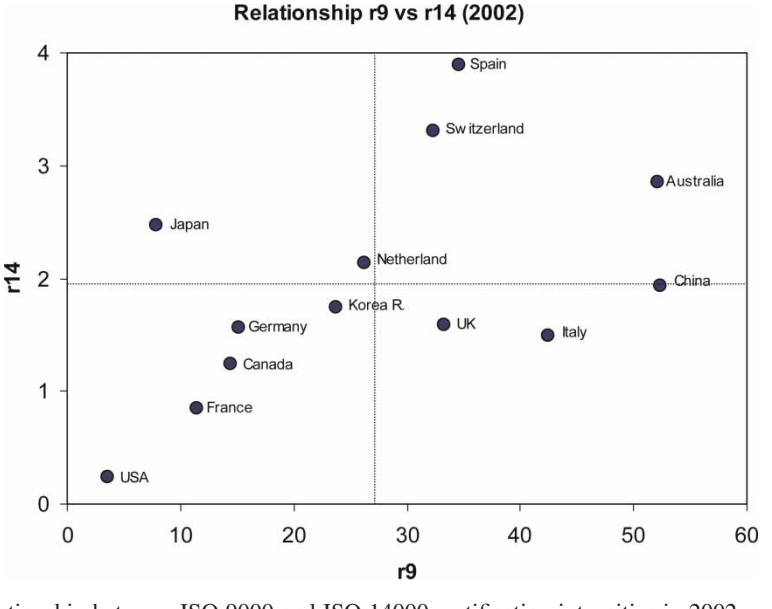


Figure 2. Relationship between ISO 9000 and ISO 14000 certification intensities in 2002.

Table 3. Pearson correlation rates among intensities of both standards over the three years analysed.

	r14 (2002)	r14 (2003)	r14 (2004)
r9 (2002)	0.501 (0.081)		
r9 (2003)		0.583 (0.037)	
r9 (2004)			0.692 (0.009)

Note: The *p*-values are shown in parentheses.

certification rate with regard to its ISO 14000 certification rate. Some explanations regarding the reasons for this 'delay' may be found in Corbett and Kirsch (2000).

A data update using the information from 2003 yields a very similar graph, with higher correlation rates and, in 2004, the correlation is even higher and more significant statistically (see Table 3). This indicates that the countries are migrating to the diagonal in Figure 2, or going in the direction of the diagonal towards upper-right. It produces a sense of focus in the figure – in other words, a certain proportionality is detected in all countries between the intensity of ISO 9000 certification with regard to the intensity in ISO 14000 certification. Those countries with more ISO 9000 certificates tend, in the long term, to also be those with more ISO 14000 intensity, and vice versa.

At any rate, for the purpose of analysing the line of development that countries seem to follow with regard to the number of certificates, the 2002 to 2004 graphs have been superimposed so as to make it possible to observe the country 'movements' detected. This graph is shown in Figure 3.

First of all, analysing Figure 3, a certain movement towards the left for some countries is observed, which must be understood as a certain drop in ISO 9000 certification intensity. Only three countries – China, Italy and Spain– are registering an increase in their ISO 9000 certification intensities over the three years, clearly showing a situation of obvious expansion.

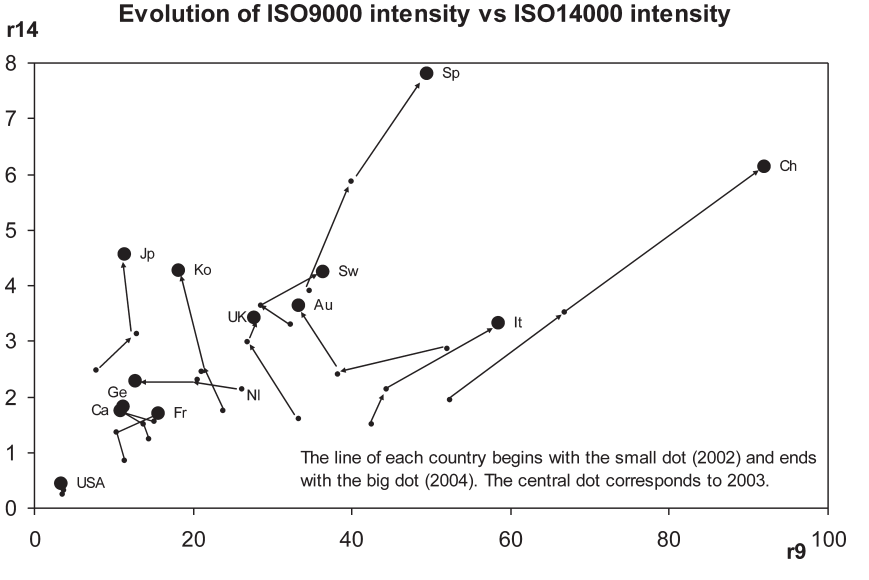


Figure 3. Evolution of the relationship between ISO 9000 and ISO 14000 certification intensities (2002, 2003 and 2004).

As far as ISO 14000 is concerned, it seems that, in general, the displacement moves upward, situating us in a period of expansion.

Indeed, analysing the previous graphs in more detail, we believe it opportune to highlight three clearly differentiated behaviours, to which we have assigned three different names: Expansionist, Mature and Retrocessive.

Expansionist behaviour

This group is made up of countries growing in their ISO 9000 and ISO 14000 certification intensity rates, 'moving' toward the upper right-hand quadrant. China, Spain and Italy particularly stand out amongst the countries studied, and, to a lesser degree, Switzerland. These countries are all in a relatively initial phase of growth as regards both standards, as is shown for instance in Figures 4 and 5. In both figures, it is clearly noted how the logistic model used characterises the number of certificates existing for both standards in both countries to a very satisfactory extent, in addition to the other ones analysed using this model. This once again confirms that the aforementioned model is valid for representing and forecasting the growth of both standards beyond the forecasts made by Casadesús et al. (2006) and Franceschini et al. (2004).

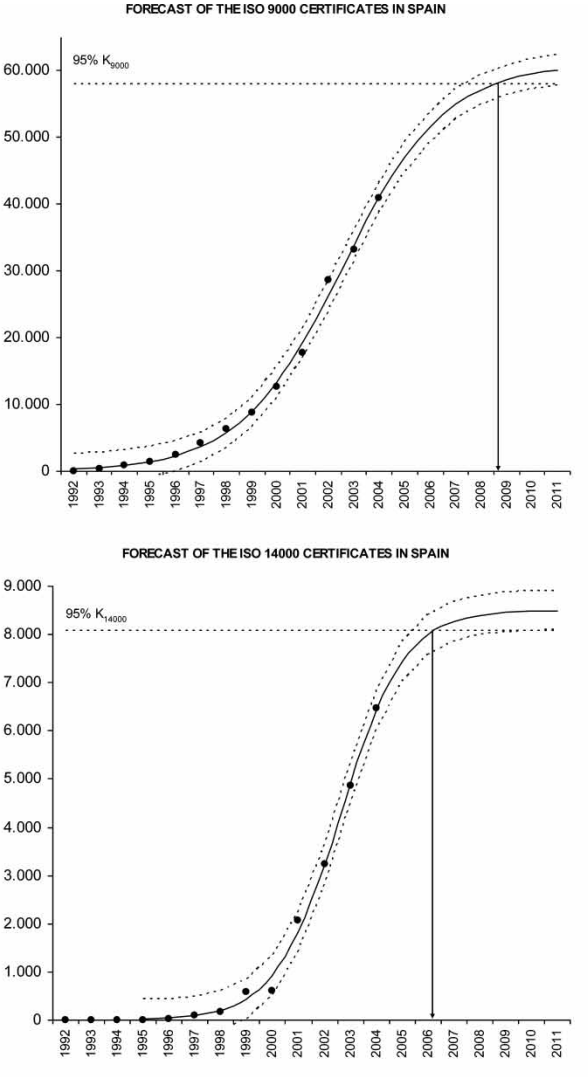
Mature behaviour

This group is made up of countries that continue to increase in their ISO 14000 intensity rate, but which otherwise are decreasing as regards the rate referring to ISO 9000. These are the majority of countries analysed and correspond to those that have already reached a certain maximum level of ISO 9000 certificates, whereas this limit has not been exceeded in the case of ISO 14000, very probably, among other reasons, because its real implementation in companies occurred much later. Of the countries analysed, the UK, Republic of Korea and Canada are found in this group, among others. All of them reached a saturation rate close to 95% with regard to the ISO 9000 logistic model some years ago.

By way of example, the forecast models carried out for both standards in the Republic of Korea and Canada are shown in Figures 6 and 7. If we focus on these two countries in terms of ISO 14000 certification, the forecast model is perfectly adjusted to the real data obtained. This proves especially interesting when the Republic of Korea is a country that is predictably just starting out according to the model shown of ISO 14000 certifications, while Canada has in fact got very close to the level of saturation envisaged. However, what occurs with the ISO 9000 certifications? As noted in the figures shown, there is not only a clear drop in the number of certifications in the two countries, but also the trend would appear to be for this to continue. Clearly, it is very difficult to conduct analyses that are other than purely exploratory, bearing in mind the few years over which this phenomenon has been detected. However, a clear drop is in fact detected in the number of certifications which one might initially expect.

Clearly, the analysis carried out would be of special local interest if it had only been conducted for these two countries. However, after carrying out the same analysis for all the countries involved in this group, the exploratory results obtained are very similar: perfectly foreseeable growth in the number of ISO 14000 certificates of up to 95% saturation of the model, to then start a relatively 'chaotic' drop in the number of ISO 9000 certificates once saturation level has been reached 'in an orderly fashion'.

It is interesting to note how, at the same moment in time, whereas for one of the standards growth continues in a relatively predictable way, for the one which has already reached the saturation limit, a drop in number has already started. This makes us think – albeit with certain caution – that what is detected is not tiredness in the use of management standards on the



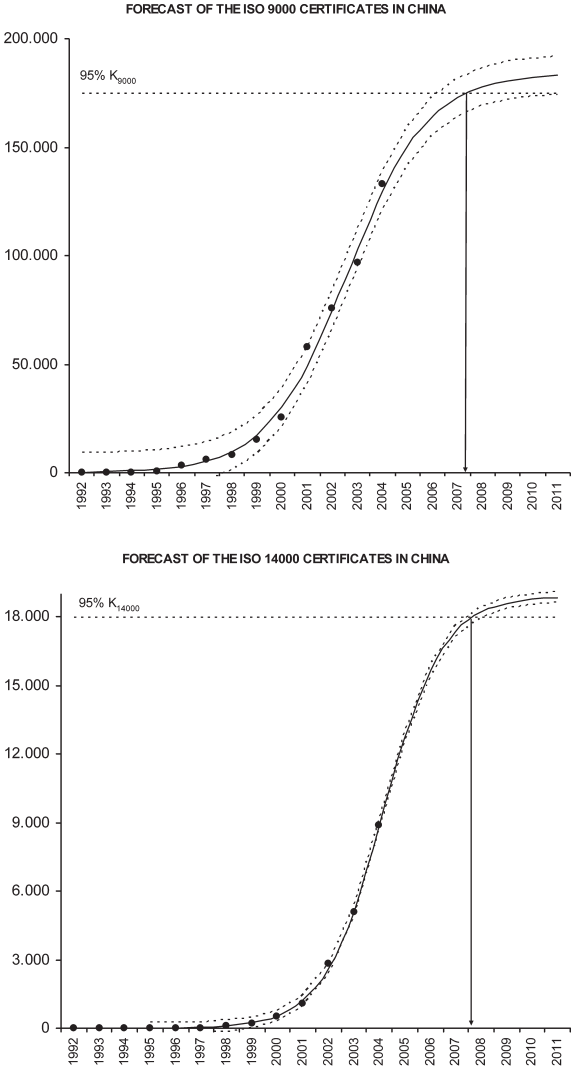
Decertification of ISO certificates in Spain considering the logistic curve.

	ISO 9000		ISO 14000	
	DF	Sum Sq	DF	Sum Sq
Decertification	3	4,206,418,265.45	3	80,734,758.04
Residual	10	10,155,728.55	7	188,508.96
Uncorrected total	13	4,216,573,994	10	80,923,267
(Corrected total)	12	2,302,241,338.92	9	48,281,618.1
R squared		0.996		0.996

	Value	LL	UL	Value	LL	UL
N_0	317.12	89.75	544.48	17.88	–3.03	38.79
K	60,972.05	45,103.44	76,840.67	8506.65	6545.03	10468.27
r_0	0.4979	0.4033	0.5925	0.8109	0.6198	1.0021

LL: Lower limit of the 95% confidence interval (the left dotted lines in the figures).
UL: Upper limit of the 95% confidence interval (the right dotted lines in the figures).

Figure 4. Decertification of ISO 9000 and ISO 14000 certifications applying the logistic curve in Spain.



Decertification of ISO certificates in China considering the logistic curve.

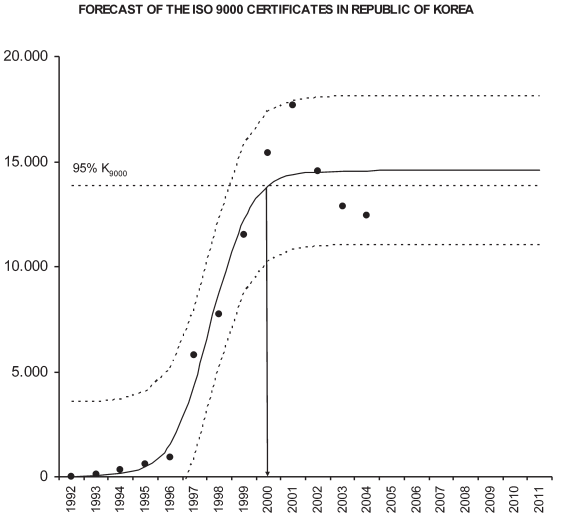
	ISO 9000		ISO 14000	
	DF	Sum Sq	DF	Sum Sq
Decertification	3	36,944,029,936.86	3	113,468,517.41
Residual	10	155,709,551.14	7	63,441.59
Uncorrected total	13	37,099,739,488	10	113,531,959
(Corrected total)	12	23,392,918,612.92	9	78,671,334.9
R squared		0.993		0.999

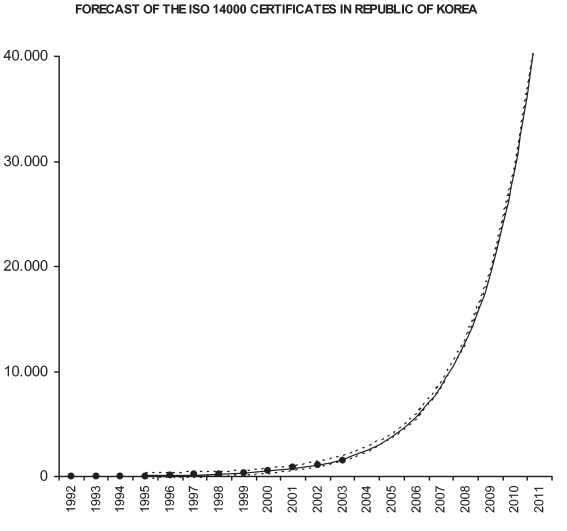
	Value	LL	UL	Value	LL	UL
N_0	237.07	–76.13	550.27	7.84	1.75	13.93
K	183,961.62	128,813.45	239,109.78	18,910.18	12,676.61	25,143.75
r_0	0.6275	0.6275	0.7845	0.8509	0.7357	0.9662

LL: Lower limit of the 95% confidence interval (the left dotted lines in the figures).

UL: Upper limit of the 95% confidence interval (the right dotted lines in the figures).

Figure 5. Decertification of ISO 9000 and ISO 14000 certifications applying the logistic curve in China.





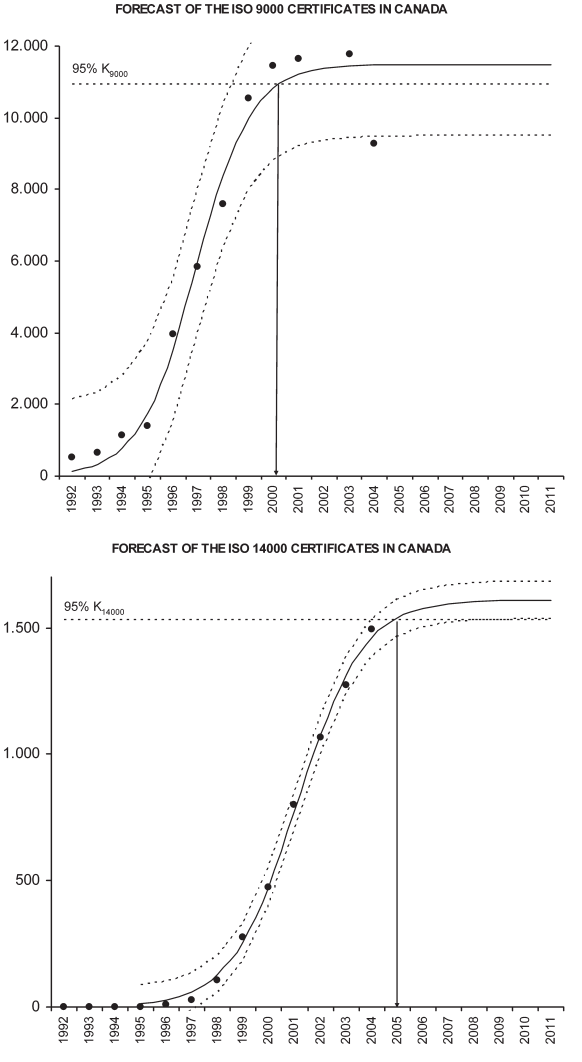
Decertification of ISO certificates in Republic of Korea considering the logistic curve.

	ISO 9000		ISO 14000	
	DF	Sum Sq	DF	Sum Sq
Decertification	3	1,282,802,108.92	3	11,373,225.80
Residual	10	25,308,684.07	7	71,777.20
Uncorrected total	13	1,308,110,793	10	11,445,003
(Corrected total)	12	539,787,448.31	9	5,946,780.5
R squared		0.953		0.988

	Value	LL	UL	Value	LL	UL
N_0	11.57	–41.74	64.87	64.12	–25,18	153,42
K	14,572.09	12,785.36	16,358.83	43,512,518,143.82	–1.178e+018	1.17796e+018
r_0	1.2599	0.4364	2.0834	0.4079	0.11304	0.7027

LL: Lower limit of the 95% confidence interval (the left dotted lines in the figures).
UL: Upper limit of the 95% confidence interval (the right dotted lines in the figures).

Figure 6. Decertification of ISO 9000 and ISO 14000 certifications applying the logistic curve in Republic of Korea.



Decertification of ISO certificates in Canada considering the logistic curve.

	ISO 9000		ISO 14000	
	DF	Sum Sq	DF	Sum Sq
Decertification	3	286,137,319.06	3	5,930,017.17
Residual	10	808,375.88	6	6214.83
Uncorrected total	13	866,495,716	9	5,936,232
(Corrected total)	12	268,716,660.92	8	2,550,632
R squared		.970		.998

	Value	LL	UL	Value	LL	UL
N_0	134.03	–105.37	373.43	12.98	3.95	22.00
K	11,495.47	10,439.54	12,551.39	1609.16	1458.38	1759.93
r_0	0.9057	0.5291	1.2823	0.7884	0.6542	0.9226

LL: Lower limit of the 95% confidence interval (the left dotted lines in the figures).
UL: Upper limit of the 95% confidence interval (the right dotted lines in the figures).

Figure 7. Decertification of ISO 9000 and ISO 14000 certifications applying the logistic curve in Canada.

part of companies, but rather the assimilating and overcoming of the requirements of each standard. This in turn leads, for instance, to the non-renewal of certificates. In other words, a standard is implemented and certified, is maintained over time and, once its requirements have been accepted by the organisation, they are no longer certified and the company focuses its attention on another standard to be implemented. In our opinion, standards may perhaps increasingly become 'use and throw away' products or, at least the certification of these standards, as once the level required is attained, it would seem that the trend will be not to certify them again, which does not mean not continuing to use the standard.

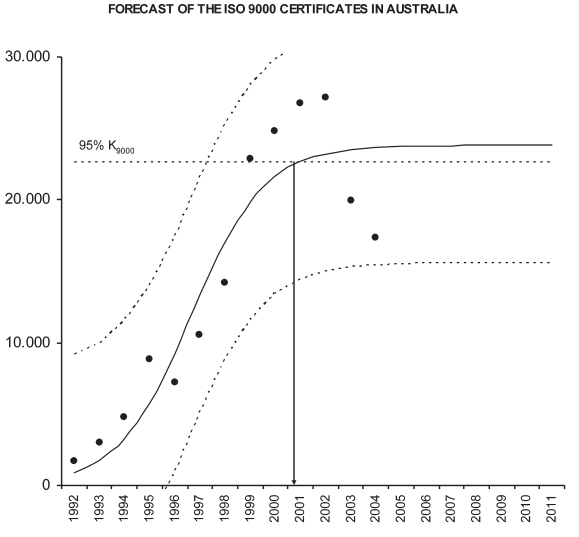
Retrocessive behaviour

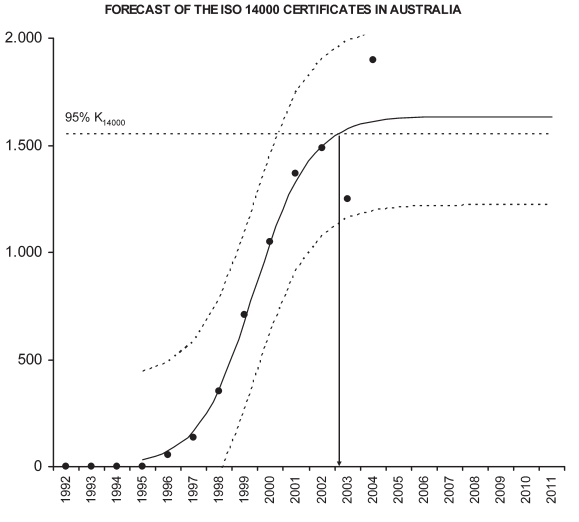
This group is made up of those countries in which a clear decertification in both ISO 9000 and ISO 14000 certification rates has been detected. Taking into account the data up until the year 2003 of the countries analysed, only Australia was in that situation. However, after adding the data referring to the year 2004 and even if the number of ISO 9000 certificates continues to gradually decrease, this is not the case with the ISO 14000 certification in which there is a sharp increase. Clearly, with a single country to analyse, it is very difficult to draw conclusions, even more so when these may be influenced by very specific aspects of each country such as a public administration campaign, funding for a certain type of certification or an error in taking into account data regarding certificates in that country. In any event, and as is noted in Figure 8, the conclusions drawn from previous behaviour would seem to be confirmed from a merely exploratory point of view: a very accurate forecast may be made using the logistic curve model in the expansive phases, but once 95% saturation in that model has been reached, behaviour is quite chaotic, and generally evidences a continued decrease. It is clear that more reliable conjectures cannot be put forward from the little data available – that is, faced with a phenomenon that is still so new.

Other types of behaviour

It must be pointed out that it would be possible to define another group of countries: those that have decreased in their rate as regards ISO 14000 certifications but, on the other hand, continue to grow as regards ISO 9000. In any case, no country has been found in this situation, which seems reasonable enough, since the expansion of ISO 9000 was carried out with a sufficient head start and with sufficiently more impact than that of ISO 14000. It is logical to think that these types of country have not been detected in the sample, nor will there be a possibility of their detection in analysing the rest of the population.

Following this exploratory analysis and taking into account the saturation levels of the countries analysed as well as the different individual historical situations of each country, it seems logical to think that countries will pass sequentially through three states: from expansionist to mature, and from this to retrocessive. In some way, it is possible that the model followed by Australia is the one which most countries are gradually going to follow: continued growth in certain management standards which may be perfectly forecast by means of a logistic curve, whereas others are decreasing from the same moment as they reach their saturation level. It is true that such a conclusion has been reached in a relatively 'provocative' manner but, on the other hand, it is impossible to go further indepth as to results when such decertification only began to be detectable one or two years ago. However, it is also true that this analysis is very interesting, particularly if it is proven that the patterns followed by the leading countries are applicable to the others, even more so at a time when the number of management standards is constantly growing (for instance, with recently approved standards such as ISO 10002 and





Decertification of ISO certificates in Australia considering the logistic curve.

	ISO 9000		ISO 14000	
	DF	Sum Sq	DF	Sum Sq
Decertification	3	3,628,443,650.89	3	10,800,212.82
Residual	1	136,352,640.11	7	193,964.18
Uncorrected total	13	3,764,796,291	10	10,994,177
(Corrected total)	12	1,014,031,321.08	9	4,100,196.1
R squared		0.866		0.953

	Value	LL	UL	Value	LL	UL
N_0	914.76	–1213.34	3042.86	30.39	–42.18	102.98
K	23,810.06	18,834.81	28,785.31	1635.11	1302.80	1967.42
r_0	0.6904	0.1485	1.2324	0.9061	0.3113	1.5009

LL: Lower limit of the 95% confidence interval (the left dotted lines in the figures).
UL: Upper limit of the 95% confidence interval (the right dotted lines in the figures).

Figure 8. Decertification of ISO 9000 and ISO 14000 certifications applying the logistic curve in Australia.

others that are at the draft stage, such as ISO 10001, ISO 10003 and ISO 10020, all of them related to quality management improvement).

Conclusions

Pan (2003) and Poksinska et al. (2003) have already found out that the reasons companies had in getting certified, as well as the benefits they obtained with certification, coincided for both standards. However, up to now very little analysis has been done to determine whether their dissemination followed the same parameters or not. In particular, some research work proposing dissemination models has been carried out (for example Casadesús et al., 2006; and Franceschini et al., 2004), but all of them had been carried out at a time when both standards were in a process of expansion.

However, no research has been detected regarding a new effect, such as the decrease in the number of certifications, which has been detected in recent years. First, it must be taken into account that this decertification concerns, above all, the ISO itself. In this sense, the latest report published by this organisation (ISO, 2005) regarding the number of certificates includes a brief description of the possible causes of such decertification, as well as the results of a survey about it. In the aforementioned study, it is pointed out that one of the main reasons for decertification is 'Organisation failed re-certification audit', although it must be taken into account that the main reason cited by companies (with 54.2% of answers) is 'Other reasons', whereby major conclusions cannot be drawn from this brief study.

In any case, the worldwide decertification is evident, more so if we take into account the fact that many countries ranked as worldwide economic leaders, such as Germany or the UK, are clearly immersed in this process of decertification. Without doubt, the total number of certificates throughout the world is maintained thanks to the impact of the more incipient countries, particularly China, with their very low saturation levels in forecast logistic models.

On discovering the first countries showing certain decertification in the number of ISO 9000 and ISO 14000 certificates, this article has sought to analyse their pattern. A first approach is found on detecting that this decertification begins once the number of certificates has reached 95% of the degree of saturation shown by the logistic model. Will this be the pattern for all the countries involved? In particular, will it apply to those that are in their first stages of growth? Needless to say, the low number of countries in which such decertification has been detected, and in particular the short period of time during which it has been detected – not more than one or two years – does not make it possible to make too many conjectures.

However, from the analyses carried out, it has been possible to define three types of country in terms of an expansion in both standards: the countries showing 'expansionist', 'mature' and 'retrocessive' behaviour. In the first case, those countries showing a constant growth in the number of certifications according to both standards would be included – growth that may easily be modelled by means of logistic curves. Countries showing 'mature' behaviour would be those in which the number of ISO 9000 certifications has reached 95% expansion, according to the model used, and a process starts involving a decrease in certified companies which is difficult to model, whereas the number of certified companies according to the ISO 14000 standard continues to grow. Lastly, in countries showing 'retrocessive' behaviour, those countries would be included in which the level of certifications decreases in the case of both standards.

In any event, the most interesting thing about the types detected is to note how the impact of one standard has already started to decrease in the same country, at the same moment in time as another continues its 'predictable' growth. This is closely related to the first hypothesis which we believe is interesting to formulate. That is why, by basing ourselves on the experience gained from our prior research and the practitioner and academic literature available, we consider it

appropriate to conclude this exploratory pilot article by announcing a series of work proposals, which we deem to be of interest and which one might attempt to investigate contrast in subsequent research.

The first, as we have mentioned, is related to the possible loss of appeal of the implementation of MSS, due to the fact that the intrinsic value of the certificates supporting such implementation loses value as the total number of certificates increases. Indeed, we understand that there are by no means few companies – as has been pointed out to us, at least in empirical studies carried out (Casadesús et al., 2001; Casadesús & Karapetrovic, 2005) – which have embarked on the process of implementation and certification of ISO 9000 standards motivated by the competitive advantage and the differentiation of image resulting from having the certificate. It would seem obvious that the intrinsic value of the certificate is not constant, but rather that it tends to decrease in an environment in which the fact of possessing the aforementioned certificates does not prove to be a distinguishing factor for companies. In our opinion, and linked to this fact, it proves interesting to analyse the hypothesis of the competition factor involved for the dissemination of MSS such as ISO 9000 and ISO 14000 of business management general models, also known as models of excellence, such as EFQM, Malcolm Baldrige and the Deming model. All this would mean that, as companies steadily implement, take on and certify a certain standard, it will make sense to certify it for a period of time, but gradually this certification will lose its importance, resulting in its being discontinued. Of course, this does not mean that that standard is not used, but rather that it is simply not certified. From then on, the company will focus its attention on other standards or models that it will probably be more interested in certifying, either to show this to its customers and competitors or to ensure their proper implementation.

On the other hand, and as authors such as Delmas (2002) and Potoski and Prakash (2004) have stated, it is clear that the political and regulatory context of each country and, in particular, the prescriptive role of Public Administration plays a fundamental role in extending these MSS: direct or indirect grants for the implementation and certification of these systems may play a major role in the growth of certificates in a specific country, but also in the decertification process (as is the case of Australia, for instance, in which very particular behaviour is detected, probably for these reasons). We understand that this is an issue that should be contrasted in subsequent studies.

Similarly, we consider that it may also prove interesting to carry out an indepth study on possible losses in terms of certifications owing to a lack of confidence in the system (Casadesús & Karapetrovic, 2005) and, in particular, if decertification can be explained due to the fact that there may be a trend in companies which, although they have implemented the system to a substantive extent in their organisations rather than merely symbolically – as many companies do according to some studies (Christmann & Taylor, 2005) – they have no incentive to become certified.

As has been stated, we understand that all these reflections and working hypotheses in the broadest sense of the word and which we leave open for study in the future, are of great interest to researchers who are working in MSS lines of research – a line of research that is gradually making its way into the academic field, as well as being of interest to different agents involved in the MSS dissemination process (e.g. multinational companies, accreditation and certification bodies, consultants, public sector agencies).

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